

Parental age difference, educationally assortative mating and offspring count: evidence from a contemporary population in Taiwan

Meng-Wen Tsou¹, Jin-Tan Liu²
and James K. Hammitt^{3,*}

¹Graduate Institute of Industrial Economics, National Central University, 300 Jhongda Road, Jhongli City, Taoyuan County 32001, Taiwan, Republic of China

²Department of Economics, National Taiwan University and NBER, 21 Hsu-Chow Road, Taipei 100, Taiwan, Republic of China

³Center for Risk Analysis, Harvard University and Toulouse School of Economics (LERNA-INRA), 21, allée de Brienne, 31000 Toulouse, France

*Author for correspondence (jkh@harvard.edu).

Using contemporary population data from Taiwan, we examine the relationships between parental age difference, educationally assortative mating, income and offspring count. Controlling for women's reproductive value (measured by age at first birth), we find that an older husband is associated with fewer offspring, whereas a husband with similar or higher education is associated with more offspring. Concerning resources, we find that women's income is negatively associated with fertility and husband's income is positively associated with fertility among highly educated women. These results are consistent with the view that women compensate for trade-offs between education, income generation and childbearing by seeking mates with a higher status.

Keywords: offspring count; age; education

1. INTRODUCTION

Mating preferences are determined by a host of interrelated psychological, sociological, cultural and economic factors. In most societies, men marry younger women and women marry older men. Women are more likely to have mates with similar or higher educational attainment. These patterns reflect the stylized fact that men usually desire younger partners with higher reproductive capacity and women usually desire men with more resources and higher status [1]. From an evolutionary perspective, it is of interest to determine whether preferences regarding age and educational differences enhance fitness as measured by offspring count and whether the relationships persist in modern societies with access to social income support and modern birth-control methods.

An early study by Bereczkei & Csanaky [2], using county survey data from Hungary, found that men marrying younger women had significantly more children than men who married older women. Using English data, Manning & Anderton [3] reported

a maximum offspring count when the husband was 2–3 years older than his wife. Two more-recent studies also found an inverted U relationship. Using data for the seventeenth- through nineteenth-century Sami population in northern Finland, Helle *et al.* [4] found that men maximized their offspring count by marrying women approximately 15 years younger. Fieder & Huber [5], using contemporary Swedish data, found offspring count was maximized for men marrying women 4 years younger, and for women marrying men 6 years older. Lindqvist *et al.* [6] criticized this study for failing to control for a potentially important confounder, reproductive value. By including 'woman's age at marriage', they concluded that the relationship between parental age difference and offspring count is spurious. In reply, Fieder *et al.* [7] confirmed that their results were robust to including 'woman's age at first birth' in their model, a variable they claimed is a better measure of reproductive value than age at marriage.

With regard to parental education, Mascie-Taylor [8] found that the education difference between husband and wife is positively associated with offspring in British data. For American women, Huber *et al.* [9] found that husband's income is related to offspring count for highly educated women, suggesting that resources are important for increasing modern female reproduction.

Given the absence of studies on contemporary developing countries, we examine the relationship between parental age difference and offspring count in Taiwan. We also investigate the relationships between education, income and fertility. After adjustment for women's reproductive value, we find that marrying an older man or a less educated man is associated with fewer offspring. Resource availability, measured by husband's income, is associated with more offspring among highly educated women. Recognizing that the optimal age difference cannot differ by sex [10], we fit a quadratic model of woman's and man's age at first birth [11] and find that offspring count declines with woman's age and exhibits an inverted U-shaped relationship with man's age.

2. MATERIAL AND METHODS

We used 1978–2006 national birth register data to derive fertility histories for Taiwanese women born in 1961–1966. For each birth, the register contains parents' ages and years of education. We used the unique parents' personal identifiers to link birth records and calculated the number of children produced by each couple. Our analysis was restricted to women aged 40–45 years in 2006, who had largely completed childbearing. We included only women who bore children with the same father. Information on parental income was obtained from the 2005 government-employee and labour-insurance files that cover the vast majority of public- and private-sector employees.

Our large national dataset, combining highly accurate offspring counts with parental education and income, allows us to assess the relationship between socio-economic status and offspring count. Our analysis is limited to couples producing at least one child.

Parental age difference is father's age minus mother's age. Completed schooling is categorized as elementary, junior high, senior high, college and graduate school. After excluding observations missing father's income, 680 526 couples (of 862 488) remain for analysis. Mothers absent from the insurance files for whom spousal income was available were assumed to have no market income. Mean age and education differences are 3.0 and 0.4 years, respectively. Mothers average 25.3 years at first birth (1st, 99th percentile = 17, 37) and fathers average 28.3 years (1st, 99th percentile = 19, 42). Offspring count averages 2.3.

3. RESULTS

For comparability, we begin by replicating the specifications proposed by Fieder & Huber [5] and Lindqvist *et al.* [6]. Offspring count is regressed on parental age difference, parental age difference squared and woman's age at first birth. We examine effects of educationally assortative mating and resource availability by adding parental income, education and differences in education.

Without controlling for female reproductive capacity, the linear model in column 1 of table 1 implies that a same-age couple averages 2.21 children and a 1 year increase in age differential is associated with 0.02 additional children. The quadratic model in column 2 implies that offspring count is maximized when the husband is 8 years older than his wife, 5 years more than the mean age difference. The relationship between parental age difference and offspring count is displayed in figure 1.

Controlling for woman's age at first birth (a proxy for reproductive value) increases goodness of fit and substantially affects the estimated relationship between parental age difference and offspring count. In the linear model (column 3), the coefficient on age difference is much smaller and significantly less than zero. One possible explanation for the drastic change is that reproductive value is correlated with age difference. Indeed, the correlation between age difference and woman's age at first birth is -0.35 . Women who married before 30 average 3 years younger than their husbands, significantly more than the 1 year difference among those who married after 30. This pattern accords with propositions on mate selection in evolutionary models and is similar to patterns found in most cultures [12].

Consistent with expectations, women who first gave birth at younger ages have higher offspring counts. A 1 year increase in age at first birth is associated with 0.07 fewer children. Note that the magnitude of this coefficient is much larger than the coefficient of age difference, suggesting that female reproductive capacity is more important in determining offspring count.

The quadratic model that controls for reproductive value (column 4) suggests that offspring count declines monotonically over positive age differences. Controlling for reproductive value, an older husband is associated with smaller offspring count. These results provide little support for the hypothesis that age difference *per se* entails a fitness advantage. They are consistent with evidence for pre-modern Swedish populations [6] but contrast with those for Hungary [2], England [3], Sami populations of pre-industrial Finland [4] and contemporary Swedish populations (Fieder & Huber [5]).

It is well recognized that socio-economic status is associated with fertility timing and offspring count. We use educational attainment and income as measures of socio-economic status. As shown in column 5, offspring count is strongly negatively related to woman's education and income.

To assess the relationship between educationally assortative mating and offspring count, we interacted a woman's education with dummy variables for differences in spousal education: *same* indicating the spouses have equal education and *higher* indicating the

husband has more education. In our sample, only 22.3 per cent of women marry men with less education, whereas 42.5 and 35.2 per cent marry men with the same and higher educational attainment, respectively.

Spousal education interactions are included in column 6. The reference group is couples in which the woman completed junior high school and the husband has less education. To examine whether the association between husband's resources and offspring count varies by woman's education, we include interactions of woman's education level and husband's income. Women marrying men with less education have fewer offspring than those marrying men with comparable or more education. Average offspring count is largest for couples in which both spouses have only elementary-school education. The association between educational difference and offspring count is consistent with evidence found for Britain [8] and Hungary [2]. Offspring count is significantly positively associated with husband's income among women in the higher education categories (senior high school or more). This coincides with evidence for the USA [9], suggesting that financial resources are important for increasing modern female reproduction. Note that controlling for educationally assortative mating and husband's income has virtually no effect on our primary result that parental age difference is negatively associated with offspring count.

Boyko [10] notes that the age difference at which offspring count is maximized in a population cannot differ between women and men (the Fisher condition). Kokko [11] illustrates how, despite the Fisher condition, optimal mate choice can differ between sexes and regressions of offspring count on parental age difference may fail to identify these conditions. We extend Kokko's quadratic model to include an interaction between mother's and father's age at first birth. As shown in table 2, offspring count declines with woman's age at first birth. Offspring count is a hump-shaped function of man's age with a maximum that depends on the woman's age and is decreasing for positive age differences and observed woman's ages.

4. DISCUSSION

Our study differs from previous work in several important dimensions. First, our national population dataset provides a large sample with high-quality data. Second, we provide evidence for a recent cohort in a developing Asian country. We examine the relationships between reproductive consequences and mate choice considering not only spousal age difference but also educational differences and resource availability. Finally, we estimate a model that describes offspring count as a richer function of woman's and man's ages at first birth, not simply their age difference.

We find assortative-mating patterns by age and educational attainment in Taiwan that are similar to those in many societies. On average, women who married before age 30 were 3 years younger than their husbands, whereas those who married later were only 1 year younger. More than 40 per cent of husbands and wives have the same educational attainment.

Table 1. Parental age difference and offspring count. (Dependent variable is number of offspring. Results are estimated by OLS, with robust standard errors in parentheses. Models in columns 5 and 6 include interactions between woman's age at first birth and woman's education level variables.)

	1	2	3	4	5	6
age difference	0.0165*** (0.000312)	0.0398*** (0.000475)	-0.0190*** (0.000294)	-0.0135*** (0.000450)	-0.0118*** (0.000507)	-0.0117*** (0.000508)
age difference squared		-0.00253*** (4.91e - 05)		-0.000574*** (4.24e - 05)	-0.000917*** (5.20e - 05)	-0.000855*** (5.20e - 05)
woman's age at first birth			-0.0740*** (0.000197)			
woman's education level						
junior high					-0.2604*** (0.0188)	
senior high					-0.4817*** (0.0181)	-0.1795*** (0.0149)
college					-0.5632*** (0.0255)	-0.2466*** (0.0237)
graduate					-0.4205*** (0.0303)	-0.1271*** (0.0296)
woman's income					-3.71e - 07*** (7.03e - 08)	-2.71e - 07*** (7.11e - 08)
woman's education level × same						
elementary × same						0.3374*** (0.0192)
junior high × same						0.1394*** (0.0053)
senior high × same						0.0419*** (0.0034)
college × same						0.0125* (0.0070)
graduate × same						0.0356*** (0.0056)
woman's educational level × higher						
elementary × higher						0.2890*** (0.0196)
junior high × higher						0.0474*** (0.0053)
senior high × higher						0.0314*** (0.0039)
college × higher						0.0667*** (0.0063)
woman's educational level × husband's income						
elementary × husband's income						-3.56e - 07*** (1.78e - 07)
junior high × husband's income						1.78e - 07 (1.20e - 07)
senior high × husband's income						
college × husband's income						7.45e - 07*** (9.03e - 08)
graduate × husband's income						8.35e - 07*** (1.66e - 07)
constant	2.208*** (0.00123)	2.186*** (0.00122)	4.190*** (0.00556)	4.172*** (0.00568)	4.530*** (0.0157)	4.193*** (0.0118)
observations	862 488	862 488	862 488	862 488	680 526	680 526
R ²	0.004	0.009	0.140	0.140	0.147	0.149

* $p < 0.1$.** $p < 0.05$.*** $p < 0.01$.

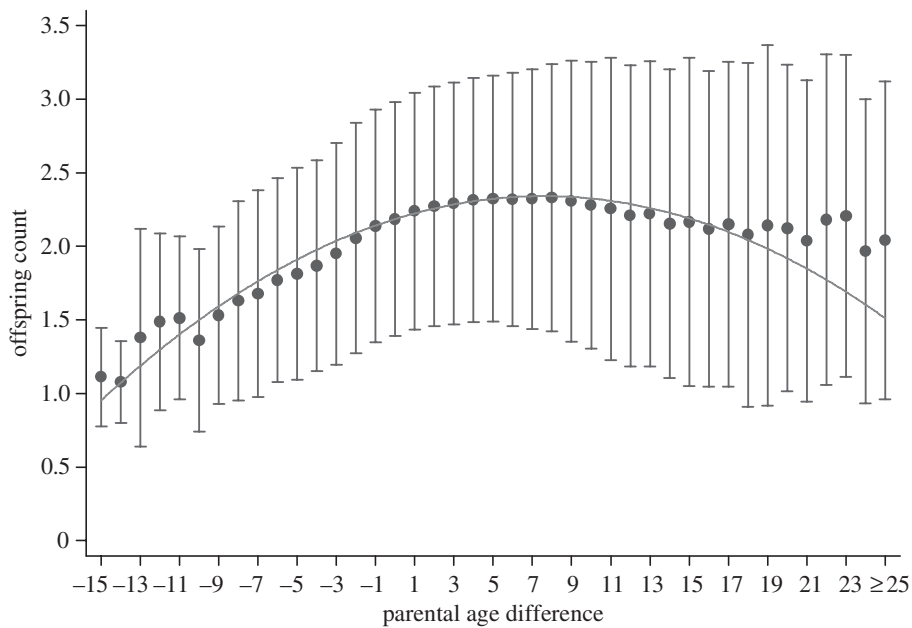


Figure 1. Mean offspring count (\pm s.d.) of Taiwanese women aged 40–45 years who did not change their partner. Data for age difference more than 25 years are aggregated. Smooth curve is a regression line from table 1, column 2.

Table 2. Parents' ages at first birth and offspring count. (Dependent variable is number of offspring. Results are estimated by OLS, with robust standard errors in parentheses.)

woman's age at first birth	−0.0845*** (0.00198)
square of woman's age at first birth	0.000140** (6.01e − 05)
man's age at first birth	0.0185*** (0.00183)
square of man's age at first birth	−0.000924*** (4.62e − 05)
woman's age at first birth \times man's age at first birth	0.000712*** (9.03e − 05)
constant	4.022*** (0.0262)
observations	861 898
R^2	0.140

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

Our empirical results indicate that the positive relationship between parental age difference and offspring count can be largely attributed to the higher reproductive success of women who give birth at younger ages. After controlling for a woman's reproductive value (measured by age at first birth), an older husband is associated with fewer offspring. Therefore, our results strongly support the view that it is reproductive value rather than age difference *per se* that is associated with offspring count. This result is supported by modelling offspring count as a function of parental ages at first birth, which implies that offspring count decreases with woman's age at first birth. Moreover, we find that educationally assortative mating is strongly associated with offspring count. Women who married men with less education have fewer children than those who married men with equal or more education.

In the contemporary Taiwanese setting, with access to social support programmes and modern birth-control methods, increases in women's educational attainment, workforce participation and income are associated with lower fertility. To compensate for

trade-offs between education, income generation and childbearing, women may increase their reproductive output by seeking mates with more resources.

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